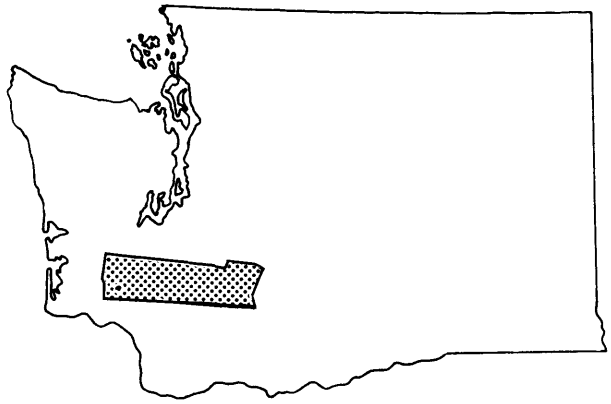
FLOOD INSURANCE STUDY

TOWN OF PE ELL, WASHINGTON
LEWIS COUNTY



SEPTEMBER 1979

FEDERAL EMERGENCY MANAGEMENT AGENCY
FEDERAL INSURANCE ADMINISTRATION

COMMUNITY NUMBER - 530296

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1.0 INTRODUCTION

1.1 Purpose of Study

The purpose of this Flood Insurance Study is to investigate the existence and severity of flood hazards in the Town of Pe Ell, Lewis County, Washington, and to aid in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. Initial use of this information will be to convert Pe Ell to the regular program of flood insurance by the Federal Insurance Administration. Further use of the information will be made by local and regional planners in their efforts to promote sound land use and flood plain development.

1.2 Coordination

The identification of streams selected for detailed analysis was accomplished in a meeting attended by representatives of the community, a study contractor formerly identified to perform the study, but not subsequently brought under contract, and the Federal Insurance Administration on April 14, 1976. A later meeting was attended by representatives of the county, Tudor Engineering Company (the finally selected study contractor), and the Federal Insurance Administration on July 6, 1976.

During the course of the work, numerous information contacts were made by the study contractor with the community for the purpose of obtaining data and acquiring base map material.

On April 10, 1978, the results of the work were reviewed at an interim technical meeting attended by representatives of the study contractor, the Federal Insurance Administration, and the Town of Pe Ell.

The results of this study were reviewed at a final community coordination meeting held on September 19, 1978. Attending the meeting were representatives of the Federal Insurance Administration, the study contractor, and the town. This study incorporates all appropriate comments, and all problems have been resolved.

1.3 Authority and Acknowledgments

The source of authority for this Flood Insurance Study is the National Flood Insurance Act of 1968, as amended.

The hydrologic and hydraulic analyses for this study were performed by Tudor Engineering Company, for the Federal Insurance Administration, under Contract No. H-4025. This work, which was completed in May 1978, covered all significant flooding sources affecting the Town of Pe Ell.

2.0 AREA STUDIED

2.1 Scope of Study

This Flood Insurance Study covers the incorporated area of the Town of Pe Ell, Lewis County, Washington. The area of study is shown on the Vicinity Map (Figure 1).

Floods caused by the overflow of the Chehalis River and Stowe Creek were studied in detail. A section of Stowe Creek between the limit of detailed study and the eastern corporate limits of Pe Ell was studied by approximate methods.

Those areas studied by detailed methods were chosen with consideration given to all proposed construction and forecasted development through 1983.

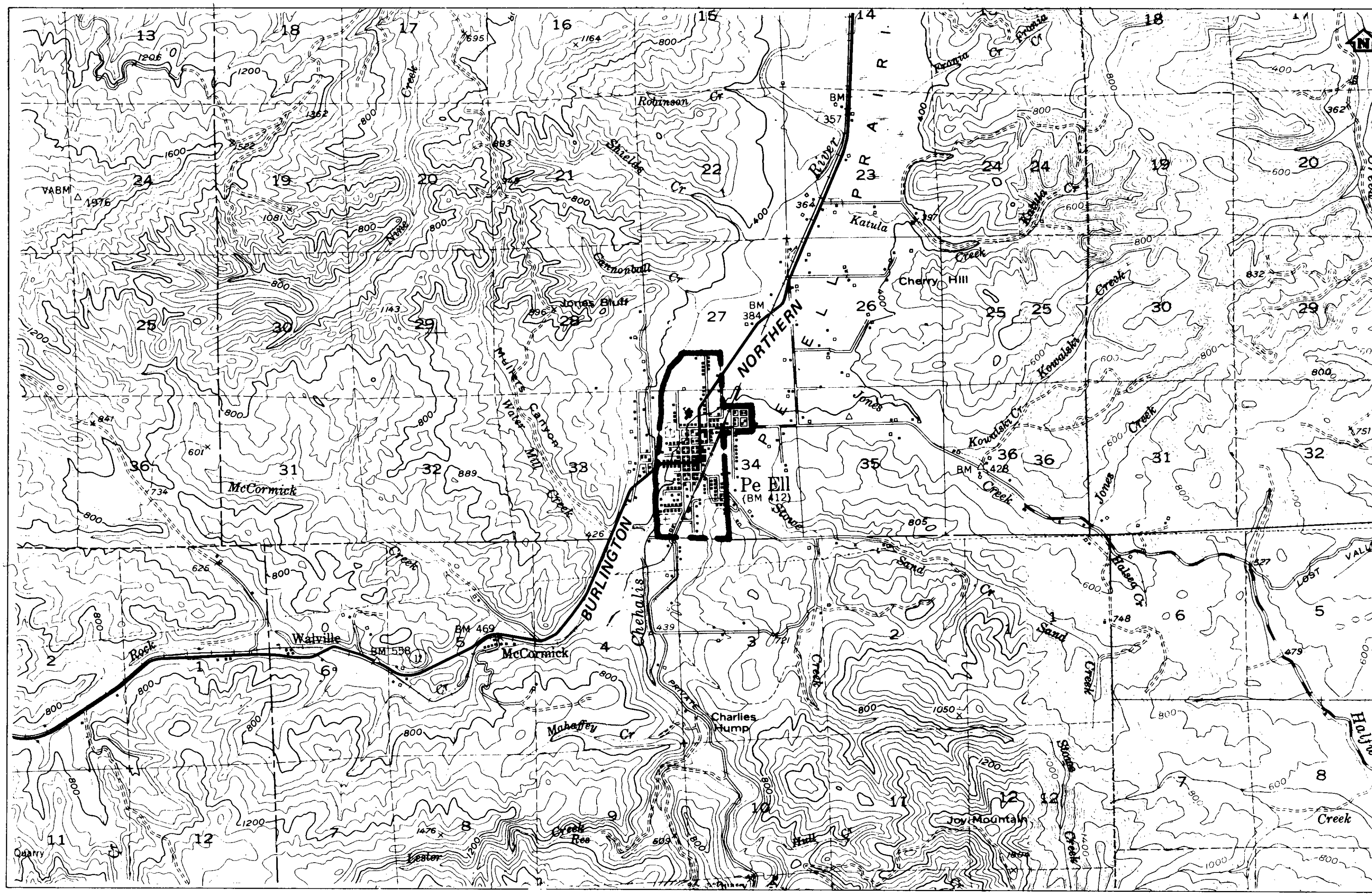
2.2 Community Description

The Town of Pe Ell is located in the western part of Lewis County, in southwest Washington. The town lies approximately 3 miles east of the Pacific County limits and 18 miles southwest of Chehalis. It lies west of Interstate Highway 5, on State Highway 6.

The town was originally intended to be named Pierre after one of the area's first white settlers. However, the name gradually evolved to Pe Ell which was more in keeping with the Indian mispronunciation of the name Pierre.

Pe Ell was platted in the 1880s by Omar Maurmann, and incorporated as a town of the fourth class on March 5, 1906. Like many of the small communities in Lewis County, the town experienced a decline in population from 838 in 1910 to 540 in 1971. Since 1971, the population has slowly increased to an estimated 660 in 1975 (References 1 and 2).

The economy of Pe Ell, and Lewis County in general, depends heavily on the lumber and wood products industry which comprised 75 percent of the total manufacturing employment of the county in 1976. With approximately 60 percent of the employable males of Pe Ell working in some branch of the timber industry, the Weyerhaeuser Company is one of the largest employers in the area.



DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

TOWN OF PE ELL, WA

(LEWIS CO.)

APPROXIMATE SCALE

1 0 1 2 3 MILES

VICINITY MAP

FIGURE 1

Pe Ell has a mid-latitude, west coast marine-type climate, typified by dry, cool summers and mild, wet and cloudy winters. The average annual precipitation is approximately 75 inches, with the bulk of this occurring from September to April. Average afternoon temperatures range from a low near 25°F in winter, to near 100°F in summer. Minimum summertime temperatures range from the mid-40s to the mid-50s. The average annual snowfall is light and seldom remains on the ground longer than one week or reaches a depth in excess of 8 to 12 inches (Reference 3).

The Chehalis River, together with its tributaries upstream of Pe Ell, drain an area of 88 square miles. Headwaters of Chehalis River originate in the steep, rugged and densely forested areas, north of Skamokawa Pass, in the southwestern corner of Lewis County. The river flows north through Pe Ell to Doty, from where it flows in an easterly direction to Chehalis and then generally northeast to its mouth in Grays Harbor at Aberdeen. Elevations within the basin range from 170 feet at Chehalis to over 2500 feet at the headwaters. The slope of the river through the Town of Pe Ell is approximately 13 feet per mile.

Stowe Creek and its tributaries upstream of Pe Ell drain an area of approximately 7 square miles. The headwaters of Stowe Creek originate in the steep, rugged slopes of Joy Mountain. The creek flows generally in an northwesterly direction from its source to its mouth where it empties into Chehalis River within the Town of Pe Ell. Altitudes range from approximately 360 feet at its confluence with Chehalis River to over 1800 feet at the headwaters. The slope of the creek through Pe Ell is very steep, averaging over 55 feet per mile.

2.3 Principal Flooding Problems

The Town of Pe Ell has no recorded history of what are commonly called major floods.

Interviews with local residents have determined that some flooding occurred in 1975 from Stowe Creek.

2.4 Flood Protection Measures

There are no existing flood protection measures in Pe Ell.

3.0 ENGINEERING METHODS

For the flooding sources studied in detail in the community, standard hydrologic and hydraulic study methods were used to determine the flood hazard data required for this study. Flood events of a magnitude which are expected to be equalled or exceeded once on the average during any 10-, 50-, 100-, or 500-year period (recurrence interval) have been selected as having special significance for flood plain management and for flood

insurance premium rates. These events, commonly termed the 10-, 50-, 100-, and 500-year floods, have a 10, 2, 1, and 0.2 percent chance, respectively, of being equalled or exceeded during any year. Although the recurrence interval represents the long term average period between floods of a specific magnitude, rare floods could occur at short intervals or even within the same year. The risk of experiencing a rare flood increases when periods greater than 1 year are considered. For example, the risk of having a flood which equals or exceeds the 100-year flood (1 percent chance of annual occurrence) in any 50-year period is approximately 40 percent (4 in 10), and, for any 90-year period, the risk increases to approximately 60 percent (6 in 10). The analyses reported here reflect flooding potentials based on conditions existing in the community at the time of completion of this study. Maps and flood elevations will be amended periodically to reflect future changes.

3.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish the peak discharge-frequency relationships for floods of the selected recurrence intervals for each stream studied in detail in the community.

Floodflow frequency data for the Chehalis River were based on a statistical analysis of discharge records at a streamflow gaging station located 3.4 miles downstream from Pe Ell. This gage has been operated since October 1939, by the U.S. Geological Survey and is identified as gage No. 120200 near Doty, Washington. The analysis was performed in accordance with standard log-Pearson Type III methods as outlined by the U.S. Water Resources Council (Reference 4).

There are no streamflow records available for Stowe Creek. Flood peaks for the design return floods were computed using rainfall-runoff relationships developed for the area and a computerized storm water routing model. The model incorporates the unit hydrography criteria developed by the U.S. Soil Conservation Service (Reference 5).

The 24-hour duration storm precipitation volumes for 10-, 50-, and 100-year return storm frequencies were obtained from the National Oceanic and Atmospheric Administration Atlas 2 (Reference 6). Precipitation volume for the 500-year storm was obtained by extending the National Oceanic and Atmospheric Administration Atlas 2 frequency curve on normal distribution probability paper. The intensity of distribution was based on Centralia rainfall gage records.

Peak discharge-drainage area relationships for the Chehalis River and Stowe Creek are shown in Table 1.

3.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of streams in the community were carried out to provide estimates of the elevations of floods of the selected recurrence intervals along each stream studied in the community.

Table 1. Summary of Discharges

Flooding Source and Location	Drainage Area (Square Miles)	Peak Discharges (Cubic Feet per Second) 10-Year	50-Year	100-Year	500-Year
Chehalis River					
At Confluence with Stowe Creek (River Mile 106.38)	95.2	15,200	20,000	23,000	28,000
At Confluence with Rock Creek (River Mile 106.71)	88.0	14,150	18,760	21,800	26,500
Stowe Creek					
At Confluence with Chehalis River	7.2	1,025	1,130	1,200	1,450

Water-surface elevations were computed through use of the U.S. Army Corps of Engineers HEC-2 step-backwater computer program (Reference 7).

Cross section data for overbank areas were developed photogrammatrically; data for wet portions of cross sections were obtained by field survey. All bridges and culverts were surveyed to obtain elevation data and structural geometry.

Locations of selected cross sections used in the hydraulic analyses are shown on the Flood Profiles (Exhibit 1). For stream segments for which a floodway is computed (Section 4.2), selected cross section locations are also shown on the Flood Boundary and Floodway Map (Exhibit 2).

Channel and overbank roughness factors (Manning's "n") were based on field inspection and photographs at each cross section location. Roughness coefficient values for the Chehalis River ranged from 0.035 to 0.040 in the channel and from 0.075 to 0.080 in the overbank. Values for Stowe Creek were 0.040 in the channel and ranged from 0.080 to 0.150 in the overbank areas.

Starting water-surface elevations for the streams studied in detail were computed by the slope-area method.

Flood profiles were drawn showing computed water-surface elevations to an accuracy of 0.5 foot for floods of the selected recurrence intervals (Exhibit 1).

Shallow flooding occurs where water from Stowe Creek overtops the Burlington Northern Railroad tracks. The tracks create a weir effect and flooding is estimated to be 1 foot in depth using normal depth calculations, a range finder, and engineering judgement.

Approximate water-surface elevations were determined in the field with a hand-held programmable calculator and a normal depth calculation program. These elevations were not tied into National Geodetic Vertical Datum, but represent the maximum channel flow depth based on an assumed thalweg elevation of zero.

All elevations are referenced to the National Geodetic Vertical Datum of 1929 (NGVD). Elevation reference marks used in the study are shown on the maps.

4.0 FLOOD PLAIN MANAGEMENT APPLICATIONS

A prime purpose of the National Flood Insurance Program is to encourage State and local governments to adopt sound flood plain management programs. Each Flood Insurance Study, therefore, includes a flood boundary map designed to assist communities in developing sound flood plain management measures.

4.1 Flood Boundaries

In order to provide a national standard without regional discrimination, the 100-year flood has been adopted by the Federal Insurance Administration as the base flood for purposes of flood plain management measures. The 500-year flood is employed to indicate additional areas of flood risk in the community. For each stream studied in detail, the boundaries of the 100- and 500-year floods have been delineated using the flood elevations determined at each cross section; between cross sections, the boundaries were interpolated using topographic maps at a scale of 1:4800, with a contour interval of 4 feet (Reference 8).

Boundaries for the approximate and shallow flooding areas, determined in the field using a range finder and based on the elevations and depths previously estimated were delineated on the maps referenced above.

In cases where the 100- and 500-year flood boundaries are close together, only the 100-year flood boundary has been shown.

Flood boundaries for the 100- and 500-year floods are shown on the Flood Boundary and Floodway Map (Exhibit 2).

Small areas within the flood boundaries may lie above the flood elevations and, therefore, not be subject to flooding; owing to limitations of the map scale, such areas are not shown.

4.2 Floodways

Encroachment on flood plains, such as artificial fill, reduces the flood-carrying capacity and increases flood heights, thus increasing flood hazards in areas beyond the encroachment itself. One aspect of flood plain management involves balancing the economic gain from flood plain development against the resulting increase in flood hazard. For purposes of the National Flood Insurance Program, the concept of a floodway is used as a tool to assist local communities in this aspect of flood plain management. Under this concept, the area of the 100-year flood is divided into a floodway and a floodway fringe. The floodway is the channel of a stream, plus any adjacent flood plain areas, that must be kept free of encroachment in order that the 100-year flood be carried without substantial increases in flood heights. As minimum standards, the Federal Insurance Administration limits such increases in flood heights to 1.0 foot, provided that hazardous velocities are not produced.

The floodways developed in this study were computed on the basis of equal conveyance reduction from each side of the flood plain.

The results of these computations are tabulated at selected cross sections for each stream segment for which a floodway is computed (Table 2).

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION		
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	WITH FLOODWAY	WITHOUT FLOODWAY (FEET NGVD)	DIFFERENCE
Chehalis River							
A	105.810	230[2]	2494	9.2	359.0	358.2	0.8
B	106.200	145[2]	2111	10.9	364.1	363.8	0.3
C	106.350	215[2]	2732	8.0	366.8	366.7	0.1
Stowe Creek							
A	0.100	26	112	11.8	387.1	387.1	0.0
B	0.210	39	172	7.8	401.3	401.3	0.0
C	0.320	78	492	2.7	408.4	408.4	0.0
D	0.470	37	125	10.6	411.5	411.5	0.0
E	0.503	100	351	3.8	416.1	416.1	0.0
F	0.710	26	125	10.6	421.0	420.6	0.4

[1]Miles Above Mouth

[2]This Width Extends Beyond Corporate Limits

TABLE 2

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

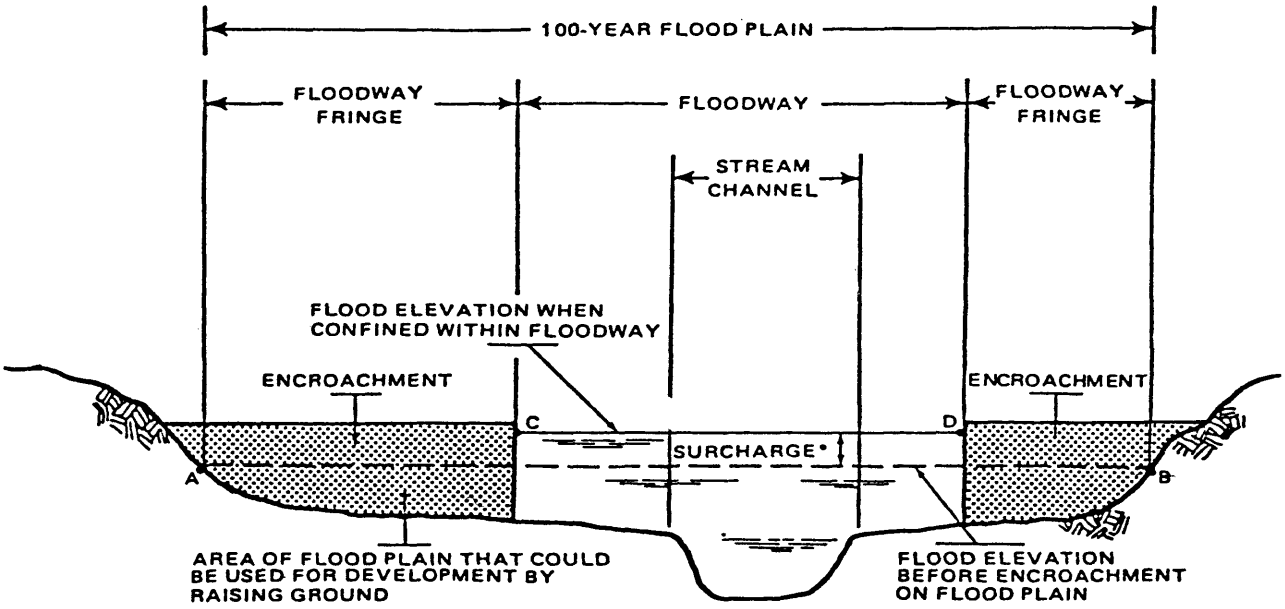
TOWN OF PE ELL, WA
(LEWIS CO.)

FLOODWAY DATA

CHEHALIS RIVER - STOWE CREEK

As shown on the Flood Boundary and Floodway Map (Exhibit 2), the floodway boundaries were determined at cross sections; between cross sections, the boundaries were interpolated. In cases where the floodway and 100-year flood boundaries are close together, only the floodway boundary has been shown.

The area between the floodway and the boundary of the 100-year flood is termed the floodway fringe. The floodway fringe thus encompasses the portion of the flood plain that could be completely obstructed without increasing the water-surface elevation of the 100-year flood more than 1.0 foot at any point. Typical relationships between the floodway and the floodway fringe and their significance to flood plain development are shown in Figure 2.



LINE AB IS THE FLOOD ELEVATION BEFORE ENCROACHMENT.
LINE CD IS THE FLOOD ELEVATION AFTER ENCROACHMENT.
*SURCHARGE IS NOT TO EXCEED 1.0 FOOT (FIA REQUIREMENT) OR LESSER AMOUNT IF SPECIFIED BY STATE.

Figure 2. Floodway Schematic

5.0 INSURANCE APPLICATION

In order to establish actuarial insurance rates, the Federal Insurance Administration has developed a process to transform the data from the engineering study into flood insurance criteria. This process includes the determination of reaches, Flood Hazard Factors, and flood insurance zone designations for each flooding source studied in detail affecting the Town of Pe Ell.

5.1 Reach Determinations

Reaches are defined as lengths of watercourses having relatively the same flood hazard, based on the average weighted difference in water-surface elevations between the 10- and 100-year floods. This difference does not have a variation greater than that indicated in the following table for more than 20 percent of the reach:

Average Difference Between 10- and 100-year Floods	Variation
Less than 2 feet	0.5 foot
2 to 7 feet	1.0 foot

Two reaches meeting the above criteria were required for the flooding sources of the Town of Pe Ell. These included one on the Chehalis River and one on Stowe Creek. The locations of the reaches are shown on the Flood Profiles (Exhibit 1).

5.2 Flood Hazard Factors

The Flood Hazard Factor (FHF) is the Federal Insurance Administration device used to correlate flood information with insurance rate tables. Correlations between property damage from floods and their FHF are used to set actuarial insurance premium rate tables based on FHFs from 005 to 200.

The FHF for a reach is the average weighted difference between the 10- and 100-year flood water-surface elevations expressed to the nearest one-half foot, and shown as a three-digit code. For example, if the difference between water-surface elevations of the 10- and 100-year floods is 0.7 foot, the FHF is 005; if the difference is 1.4 feet, the FHF is 015; if the difference is 5.0 feet, the FHF is 050. When the difference between the 10- and 100-year water-surface elevations is greater than 10.0 feet, accuracy for the FHF is to the nearest foot.

5.3 Flood Insurance Zones

After the determination of reaches and their respective Flood Hazard Factors, the entire incorporated area of the Town of Pe Ell was divided into zones, each having a specific flood potential or hazard. Each zone was assigned one of the following flood insurance zone designations:

Zone A: Special Flood Hazard Areas inundated by the 100-year flood, determined by approximate methods; no base flood elevations shown or Flood Hazard Factors determined.

Zone A0:	Special Flood Hazard Areas inundated by types of 100-year shallow flooding where depths are between 1.0 and 3.0 feet; depths are shown, but no Flood Hazard Factors are determined.
Zones A1 and A5:	Special Flood Hazard Areas inundated by the 100-year flood, determined by detailed methods; base flood elevations shown, and zones subdivided according to Flood Hazard Factors.
Zone B:	Areas between the Special Flood Hazard Areas and the limits of the 500-year flood, including areas of the 500-year flood plain that are protected from the 100-year flood by dike, levee, or other water control structure; also areas subject to certain types of 100-year shallow flooding where depths are less than 1.0 foot; and areas subject to 100-year flooding from sources with drainage areas less than 1 square mile. Zone B is not subdivided.
Zone C:	Areas of minimal flooding.

The flood elevation differences, Flood Hazard Factors, flood insurance zones, and base flood elevations for each flooding source studied in detail in the community are summarized in Table 3.

5.4 Flood Insurance Rate Map Description

The Flood Insurance Rate Map for the Town of Pe Ell is, for insurance purposes, the principal result of the Flood Insurance Study. This map (published separately) contains the official delineation of flood insurance zones and base flood elevation lines. Base flood elevation lines show the locations of the expected whole-foot water-surface elevations of the base (100-year) flood. This map is developed in accordance with the latest flood insurance map preparation guidelines published by the Federal Insurance Administration.

6.0 OTHER STUDIES

No studies concerning flooding in the Pe Ell area have been published. However, a Flood Insurance Study for Lewis County is in progress and will be in agreement with the data presented for Pe Ell (Reference 9).

FLOODING SOURCE	PANEL[1]	ELEVATION DIFFERENCE[2] BETWEEN 1% (100-YEAR) FLOOD AND			FLOOD HAZARD FACTOR	ZONE	BASE FLOOD ELEVATION (FEET NGVD)[3]
		10% (10-YEAR)	2% (50-YEAR)	0.2% (500-YEAR)			
Chehalis River							
Reach 1	0001	-2.7	-0.9	1.4	025	A5	Varies - See Map
Stowe Creek							
Reach 1	0001	-0.6	-0.2	0.7	005	A1	Varies - See Map
Shallow Flooding	0001	N/A	N/A	N/A	N/A	A0	Depth 1

[1]Flood Insurance Rate Map Panel [2]Weighted Average [3]Rounded to Nearest Foot

TABLE 3

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

TOWN OF PE ELL, WA
(LEWIS CO.)

FLOOD INSURANCE ZONE DATA

CHEHALIS RIVER-STOWE CREEK

This study is authoritative for the purposes of the National Flood Insurance Program; data presented herein either supersede or are compatible with all previous determinations.

7.0 LOCATION OF DATA

Survey, hydrologic, hydraulic, and other pertinent data used in this study can be obtained by contacting the office of the Federal Insurance Administration, Regional Director, Arcade Plaza Building, 1321 Second Avenue, Seattle, Washington 98101.

8.0 BIBLIOGRAPHY AND REFERENCES

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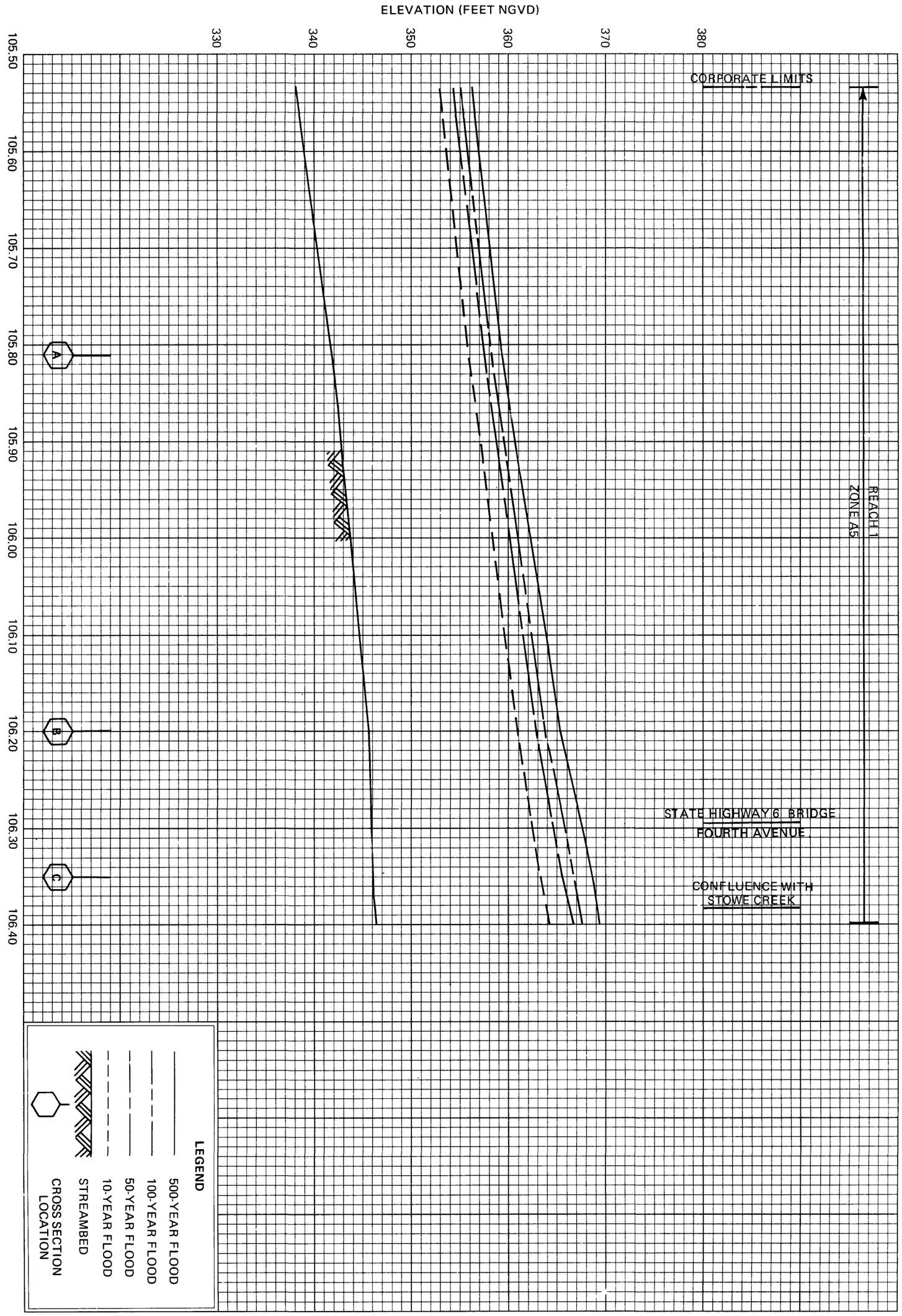

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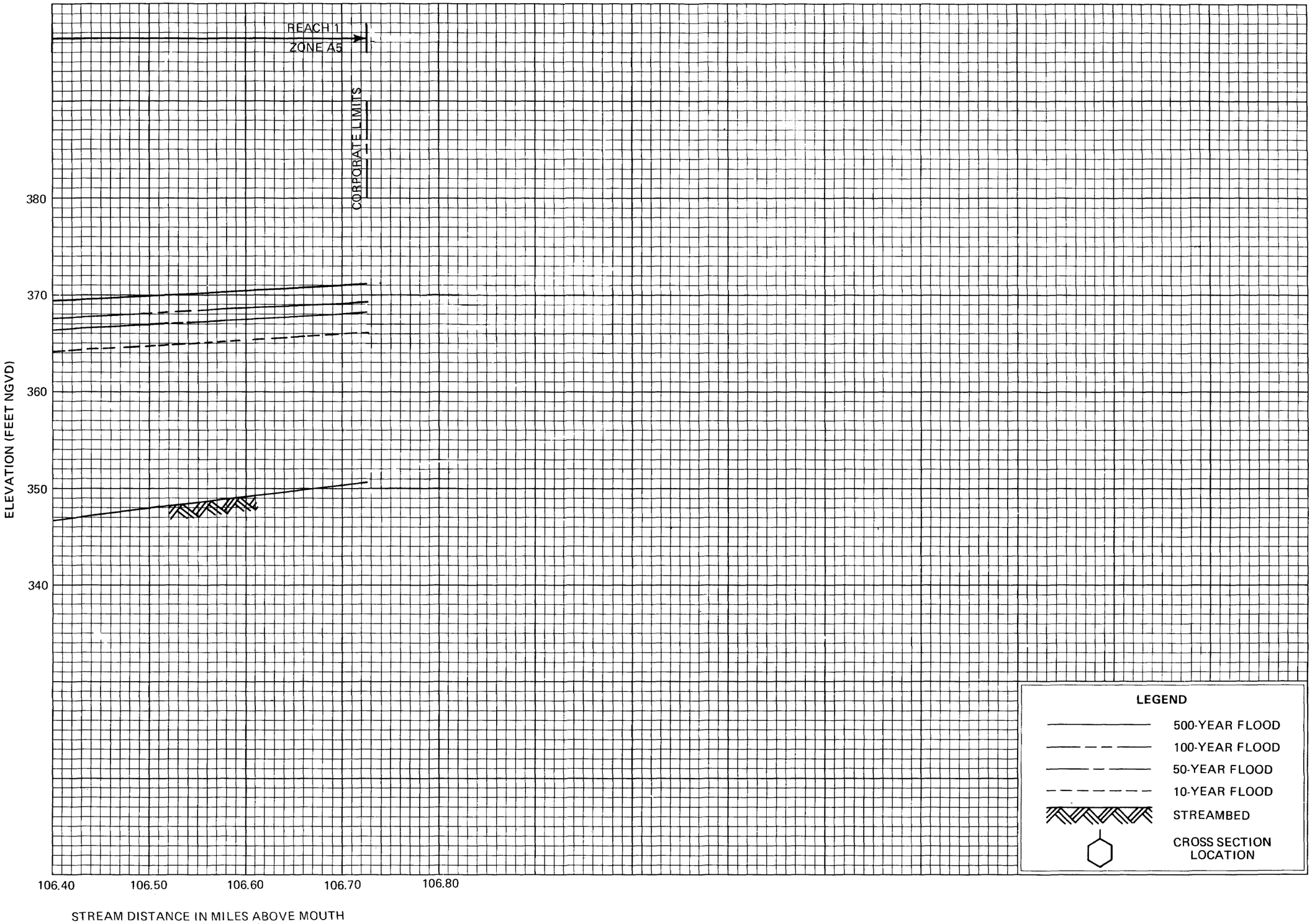
DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

TOWN OF PE ELL, WA
(LEWIS CO.)

FLOOD PROFILES

CHEHALIS RIVER



FLOOD PROFILES

CHEHALIS RIVER

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
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TOWN OF PE ELL, WA
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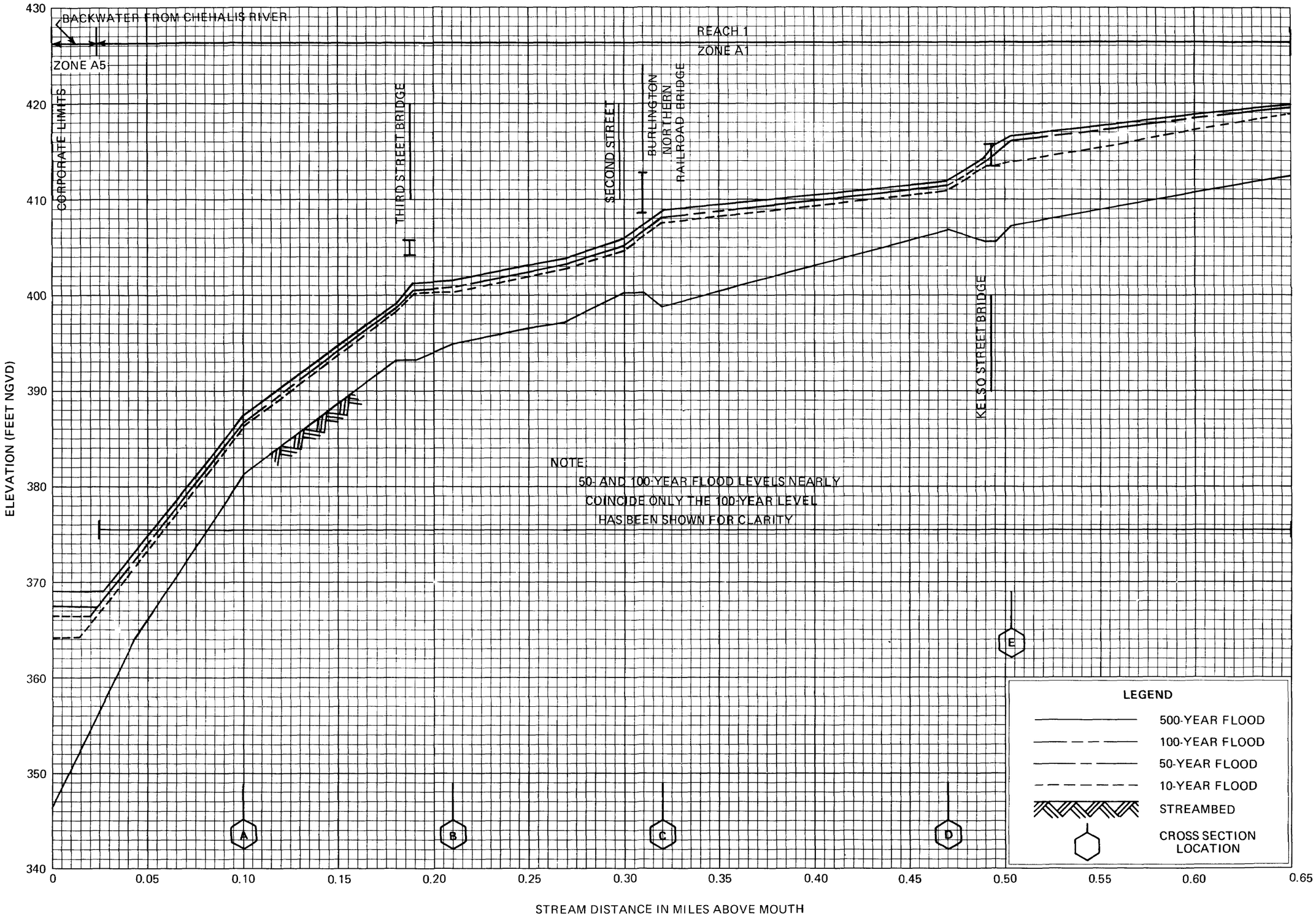

FLOOD PROFILES

STOWE CREEK

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

TOWN OF PE ELL, WA
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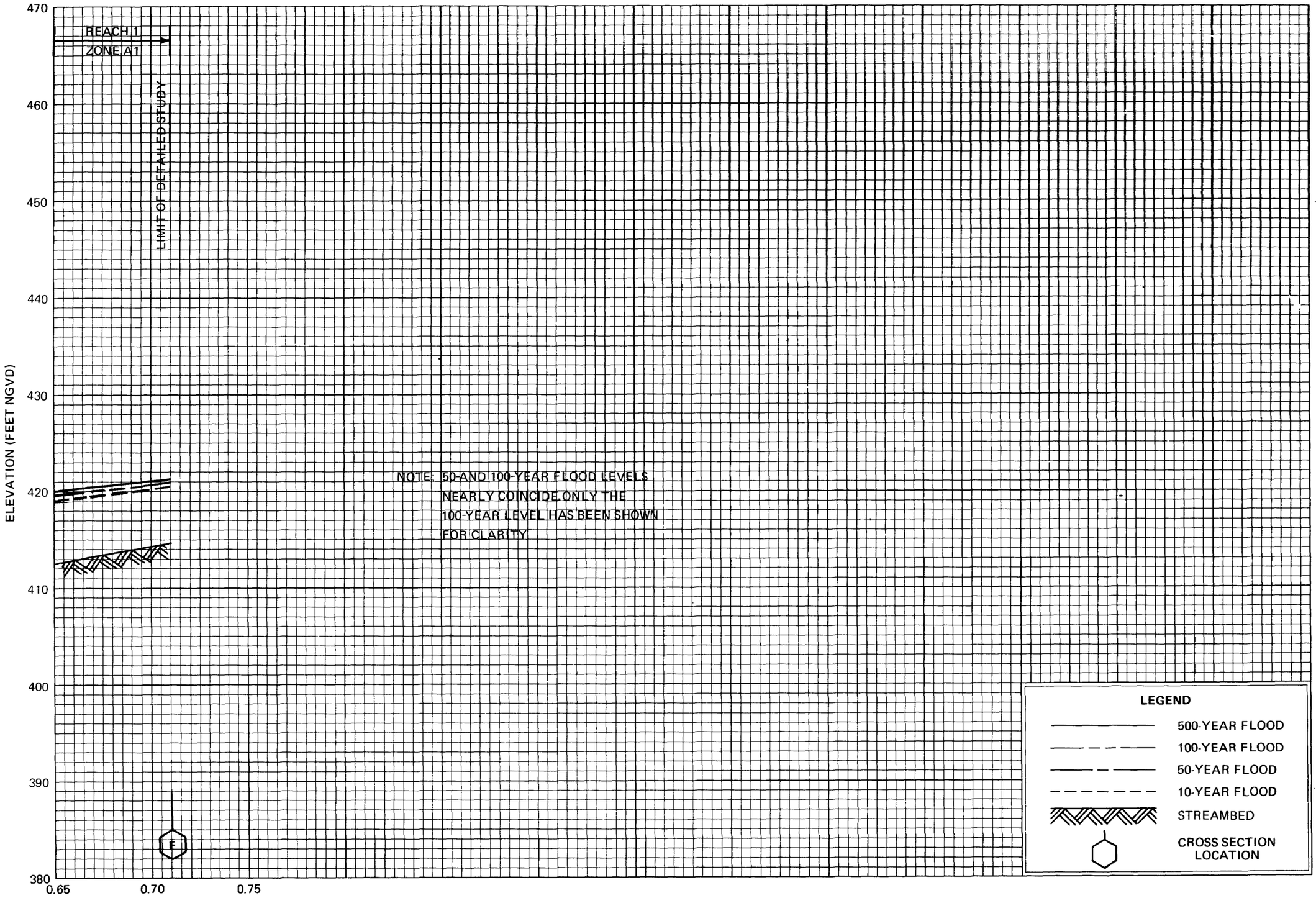

FLOOD PROFILES

STOWE CREEK

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